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PROPELLANT POWDER

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This invention relates generally to the manufacture of smokeless powders, and particularly to a process capable of producing powder charges which will be found to be clean burning.

In small arms ammunition particularly where progressive burning powder is used as the propellant it often happens that the propellant charge does not completely burn and that combustion thereof is prolonged even after the projectile or shot charge has left the barrel. This prolonged combustion is objectionable for the further reason that the burning particles of powder are expelled from the barrel of the arm behind the projectile or shot charge and the energy which would otherwise be imparted to the projectile is lost. Furthermore, some grains of powder which are not completely consumed by combustion by the time the projectile leaves the muzzle of the gun remain in the barrel particularly near the breech and there create an objectionable visual condition which is looked upon with disfavor by sportsmen and marksmen. If these particles are sufficiently large or numerous to fall in the breech or firing mechanism they may affect the functioning of the weapon and be still more objectionable.

It is among the objects of the present invention, therefore, to produce a powder charge which will be clean burning and, accordingly, the powder charge contemplated by the present invention is adapted to be completely consumed by combustion by the time the projectile or shot charge leaves the barrel whereby the objectionable condition, such as deposits in the barrel and the ejection of luminous particles of powder from the muzzle of the gun, are substantially reduced.

Efforts have heretofore been made to produce a powder charge which will be clean burning and free from the objections above set forth. It has heretofore been attempted to render powder charges clean burning by having the grains thereof substantially of the same fineness, which fineness has been low enough to permit the grains thereof to be completely consumed by combustion by the time the projectile leaves the muzzle of the gun. It is difficult, however, to obtain a progressive burning effect with particles all of which are uniform size and uniform ballistic characteristics. When the charge of powder is made of sufficient fineness as to be clean burning the grains are generally packed together to such an extent that there are insufficient voids to permit the charge to be readily ignited by the flame from the primer. In order to avoid this difficulty it has been attempted to produce a clean burning charge by the addition of a few particles of larger size in order to permit the flame from the primer to readily penetrate and ignite the charge. This, however, to a great extent defeats the initial purpose in that the larger particles continue to burn or are ejected from the muzzle of the gun behind the projectile or shot charge.

The object of the present invention, generally stated, is to provide a process of treating propellant powder grains whereby a charge thereof will be rendered clean burning.

Another object of the present invention is to provide a process of treating propellant powder grains whereby a cleaning burning charge is obtained, the grains of which vary in size but are uniform as to time of combustion.

A more specific object of the present invention is to provide a propellant powder charge the individual grains of which are uniform in at least one dimension.

Other objects will become apparent to those skilled in the art when the following description of one illustrative embodiment of this invention is read.

It is to be understood, however, that the principles of the present invention are not limited in their application to the specific type of powder hereinafter referred to for the purpose of illustration, but that the same may be utilized in the treatment of various types of powder whereby uniformity of combustion may be attained.

Generally stated in accordance with the present invention the powder which is to constitute the propellant charge which it is desired to render clean burning may be manufactured in accordance with any suitable process. The usual screening operation may then be accomplished. The selected grains, that is, those which are between the predetermined screening limits may then be softened in any suitable manner and subjected to a pressure sufficient to condense and flatten the same. In accordance with the present invention all the grains which constitute a charge may be flattened to such an extent that the thickness thereof, both large and small, is substantially uniform throughout the charge. By thus providing a charge the individual grains of which have at least one dimension which is the same throughout, it is apparent that the period of time required for complete combustion of all the grains of the charge will be the same and may be readily controlled by varying the thickness thereof. The thickness may, of course, be varied in accordance with the particular type of arm in which the ammunition is to be employed and is preferably

such, in a progressive burning powder, that combustion of the grains will be complete before the time the projectile or shot charge leaves the muzzle of the gun. The flattening may, of course, be accomplished in any suitable manner, for instance, as by passing the grain through heavy calendar rolls or otherwise subjecting the same to pressure, however, in accordance with the present invention the grains are usually first softened and subsequently flattened. Such softened and flattened grains may be recognized by the fact that their margins are substantially devoid of abrupt breaks or corners, such as would result from cutting grains from a larger sheet.

As an illustrative example of the procedure which may be followed in the preparation of a clean burning propellant powder charge in accordance with the present invention, a powder suitable for use as a shot shell propellant will be described. Such a powder may be made, for instance, from surplus cannon powder suitably treated. For instance, completely gelatinized nitrocellulose powder grains of the type suitable for cannon powder may be ground to the desired fineness and screened in the usual manner. In accordance with one embodiment of the present invention the screenings are selected which have passed a 20 mesh screen and been caught on a 100 mesh screen. It is to be understood, however, that although these screening limits are practical for a shot shell propellant the same may be varied in accordance with the conditions encountered and the type of arm in which the charge is to be fired.

In accordance with present invention a clean burning charge suitable for small arms ammunition may be produced from grains which vary in size between those which will just pass through a 20 mesh screen and those which will just fail to pass through a 100 mesh screen. Larger size particles may, of course, be employed for use in larger weapons.

The screenings obtained will be, in the above illustration, in the form of broken particles of dense smokeless powder and these may in accordance with the usual practice, be treated with suitable modifying agents in order to obtain a powder having the desired ballistic characteristics. The usual modifying agents, both deterrents and accelerators as well as water proofing agents, are preferably mild solvents for the nitrocellulose base of the powder and, accordingly, nitrocellulose powder grains tend to become soft during the application of such modifying agents. This is especially true if the treatment is carried out in an aqueous medium, and, if sufficient of the solvent is present, the grains may tend to stick together. For instance, if it is desired to treat the ground cannon powder with an accelerator such as nitroglycerine which also renders the same non-hydroscopic, the desired quantity of nitroglycerine may be dissolved in a solvent such as, for instance alcohol with or without benzol, or toluene or similar mixed solvents with or without alcohol, although it may be used by itself. The cannon powder screenings may be formed into a water slurry, the amount of water being from 3 to 8 times the weight of the powder grains, and the nitroglycerine solution may be added to this water-nitrocellulose slurry, or the nitroglycerine may be first emulsified in the water and the powder particles afterwards as introduced. If desired, a suitable deterrent such as, for instance, dibutylphthalate or D. N. T. or waxes, etc., may also be added to the mixture, or, in fact may be contained in the nitroglycerine solution. The modifying agents, nitroglycerine and dibutylphthalate, plus D. N. T. or waxes, etc., being either solvents for the nitrocellulose or lubricants, tend to soften the powder particles or facilitate their flattening. The process may be so regulated by controlling the amount of modifying agent and solvent employed that the same is completely taken up by or coated on the powder grains, it being understood, of course, that the solvent alcohol with or without benzol, may be recovered in the usual manner.

Upon the conclusion of the treatment with the modifying agents as just described the powder grains are in a softened condition or the surfaces thereof are lubricated and are admirably adapted for the treatment in accordance with the present invention. Accordingly, after penetration of the treating agents for softening of the grains to the desired extent these grains in the slurry may be subjected to pressure in order to reduce the grains along one dimension. This may be accomplished by passing the slurry of treated powder in water or other suitable vehicle through a compressing apparatus, such as rollers which may be spaced a fixed distance apart. In the case of a shot shell propellant wherein screenings between 20 and 100 mesh are employed as above described, it is preferable that even the smallest of the particles be reduced in thickness. As a practical example in the case of shot shell powder the rollers may be set at .003 inch apart. By passing the slurry between such rollers it is apparent that even the smallest of the grains is reduced in thickness by substantially one-third. This has the effect of condensing and rolling the grains into the form of flakes all having a uniform thickness. Since, however, the original screenings vary in size between 20 and 100 mesh, it is apparent that the size of the flattened particles or flakes will vary but in view of the fact that the least dimension of all the flakes is the same and it is the least dimension which determines the time of complete combustion, the time of complete combustion for the charge will be definite and predetermined and consequently the charge will be clean burning.

The procedure above described produces powder grains which in accordance with the illustrated example are flakes of completely gelatinized nitrocellulose treated with nitroglycerine and a deterrent and which have the least dimension sufficiently small to permit the same to be completely consumed by combustion by the time the projectile or shot charge leaves the muzzle of the gun. The grains are, nevertheless, of such configuration as to permit ease of ignition and permit the same, if desired, to be made progressive burning.

Another embodiment of this invention may comprise the treatment of deteriorated cannon powder either by grinding the powder to fine "dust," of which approximately 50% or more will pass through a 100 mesh screen and approximately 90% or more will pass through an 80 mesh screen. This comminuted powder may be washed with water of controlled pH, preferably buffered to maintain the pH above 7.2, and the "dust" agglomerated into particles by means of a solvent or gelatinizing agent in any suitable way, as for example, that disclosed in copending application of Serial No. 620,302, filed June 30, 1932.

Further purification may be effected after the "dust" has been agglomerated by some solvent by

washing the particles with water as described above. If the solvents have been so chosen that only very slight solubility of the solvent occurs in the water, or vice versa, suitable contact of the washing medium can be established without effecting the precipitation of the nitrocellulose.

Instead of grinding the powder, it may be dispersed in a suitable solvent and the gelatinous or lacquer-like material can be suitably washed with water, preferably buffered to maintain a pH somewhat above 7.2 as described above, or by any other suitable means, such, for example, as is disclosed in copending application of Serial No. 598,332, filed March 12, 1932, Patent Number 2,027,114 patented January 7, 1936. When the grains are prepared by any of these methods the grains may be subjected to the rolling treatment as described in the first embodiment of this invention, until all of the grains possess the characteristic of having substantially one of their dimensions the same. This rolling treatment will in effect produce flakes of substantially constant web thickness, although the face of the flakes may vary in shape and size.

It will be understood, of course, the thickness of the flakes of dense powder may be varied in accordance with the ballistic requirements and in order to secure the desired combustion period. The flakes resulting from the compressing process may, of course, be further comminuted, if desired, to secure convenient grain sizes. The flakes may, of course, be suitably surface treated as by deterrents or accelerators in order to control the various ballistic characteristics and may be graphited, screened, etc., in accordance with the usual practice prior to charging.

From the foregoing description it is apparent that many modifications in the process of making smokeless powders herein before described will present themselves to those skilled in the art without departing from the spirit of this invention. It is to be understood that the invention is not limited to the specific details set forth for the purpose of illustration or herein referred to. It is to be understood, therefore, that such modifications and the use of such individual features and subcombinations of features as do not depart from the spirit of this invention are, although not specifically described herein, contemplated by and within the scope of the appended claims.

Having thus described the invention, what is claimed is:

1. In the art of making propellant powder, the process comprising, providing grains of propellant powder, treating the grains with a plasticizer therefor to an extent sufficient to soften the grains, and subjecting the grains to a flattening pressure while they remain soft.

2. In the art of making propellant powder, the process comprising, providing grains of propellant powder, treating the grains with an explosive plasticizer therefor to an extent sufficient to soften the grains, and subjecting the grains to a flattening pressure while they remain soft.

3. In the art of making propellant powder, the process comprising, providing grains of propellant powder, treating the grains with nitroglycerine until the grains are soft, and subjecting the grains to a flattening pressure while they remain soft.

4. In the art of making propellant powder, the process comprising, providing a water slurry of propellant powder grains, treating the slurry with a plasticizer for the grains until the grains are softened, and passing the slurry through a compressing apparatus.

5. A smokeless propellant powder grain having a uniform web thickness substantially less than its width and having rounded margins devoid of sharp breaks or corners such as would result from cutting, characterized by the feature that the grain was flattened while softened by a plasticizer.

6. A smokeless propellant powder grain containing nitrocellulose and nitroglycerine, said grain having rounded margins devoid of sharp breaks or corners such as would result from cutting, characterized by the feature that the grain was flattened while softened by a plasticizer.

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